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(71) Applicant: HERCULES INCORPORATED
Hercules Plaza
Wilmington Delaware 19894(US)

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(72) Inventor: Byrne, Brian
84 Branch Brook Drive
Belleville New Jersey 07109(US)

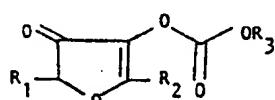
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(72) Inventor: Lawter, Louise Marie Lafleur
35 Glen Drive
Goshen New York 10424(US)

(74) Representative: De Minvielle-Devaux, Ian Benedict
Peter et al,
CARPMAELS & RANSFORD 43, Bloomsbury Square
London WC1A 2RA(GB)

(54) Pineapple ketone carbonate derivatives.

(55) A compound of the general formula,



wherein R₁ and R₂ independently are -H, -CH₃, or -CH₂CH₃; and R₃ is alkyl of from 1 to 10 carbons or aryl of from 6 to 10 carbons.

This invention relates to flavors and specifically to modified pineapple ketone.

Pineapple ketone is the common name for the chemical 2,5-dimethyl-4-hydroxy-3(2H)-furanone. This is a compound found 5 in pineapples, strawberries, raspberries, meats, and other foods. It has been found in cooked, roasted and fermented foods including coffee, roasted filbert, roasted almond and soy sauce. Pineapple ketone is known to be formed by the non-enzymatic browning process that occurs during roasting and 10 baking.

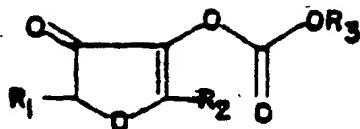
Because of its cotton-candy, carmelized-sugar flavor, pineapple ketone is used extensively to compound synthetic flavors. Pineapple ketone reacts readily with amines, aldehydes and oxygen. In such cases, the pineapple ketone 15 content of the flavors is reduced, lowering the effectiveness of the flavor.

When pineapple ketone is used in chewing-gum, it is quickly "washed out" by the chewing process, resulting in rapid loss of flavor. This "washing out" effect is due to 20 pineapple ketone being water soluble.

Willhalm, et al., U.S. Patent No. 3,455,702; Herman, et al., U.S. Patent No. 3,697,291; and Demole, U.S. Patent No. 3,983,885 disclose that flavor may be imparted to foodstuffs, beverages, meat, or tobacco by incorporating therein a minor 25 proportion of a dihydrofuran.

Bruns, et al., U.S. Patent No. 4,033,993; Grubbs, et al., U.S. Patent 4,127,601; and Boden, et al., U.S. Patent 4,397,789 each disclose carbonates used for their aroma.

A new pineapple ketone carbonate compound of the general formula,



5 wherein R_1 and R_2 independently are -H, $-CH_3$, or $-CH_2CH_3$; and R_3 is alkyl of from 1 to 10 carbons or aryl of from 6 to 10 carbons.

The invention solves the wash out problems associated with the use of pineapple ketone, while extending the flavor 10 over a longer period of time. By reacting pineapple ketone with an ethyl chloroformate or other alkyl chloroformates in triethylamine, the new and improved pineapple ketone carbonates are formed.

15 The invention relates to new carbonates derived from pineapple ketone. By forming the new carbonate derivatives, the chemical reactivity of the resulting compounds is unexpectedly reduced compared with pineapple ketone; however, the flavor of the derivatives remains very similar to the flavor 20 of pineapple ketone. This allows direct replacement of new carbonate derivatives in applications where pineapple ketone is normally used. Additionally, the increased oxidative stability of these derivatives over pineapple ketone allow their use in applications where pineapple ketone cannot be used or 25 does not perform well. Such applications include but are not limited to perfumes, dry flavors and tobacco.

Furthermore, the new carbonate derivatives are not as water soluble as pineapple ketone, which allows these derivatives to be preferentially dissolved by chewing- or bubble- 30 gum-base. This effect allows the derivatives to liberate pineapple ketone-like flavor slowly during the duration of the chew, creating a flavor prolongation effect.

The method of making new carbonates are novel because, although alcohols are known to react with ethyl chloroformate and other alkyl chloroformates to form alkyl carbonate derivatives, ketones or diones are not known to react with alkyl chloroformates to form carbonate derivatives.

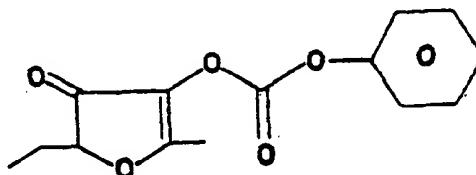
An unexpected aspect of the invention is that the subject derivatives are more stable to oxidation than pineapple ketone. Hirvi, et al. [Lebensm.-Wiss. u.- Technol., 13, 324 (1980)] have indicated how sensitive pineapple ketone is to oxidation.

At pH 4 it has a half-life of 120 days, while at pH 7 it has a half-life of 12 days. The increased oxidative stability of the subject carbonate derivatives over pineapple ketone is given in Example 3. An unexpected aspect of this invention is that the derivatives have a similar taste to pineapple ketone.

The invention offers the following advantages:

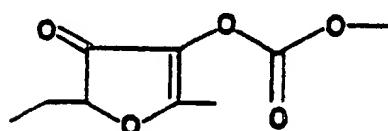
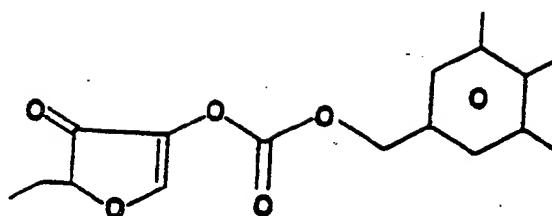
- a) The new carbonates have flavor properties similar to pineapple ketone;
- b) The new carbonates offer oxidative stabilities superior to pineapple ketone, allowing them to be used in situations where pineapple ketone will be unstable. Such situations include use as liquid flavors, and especially dry flavors;
- c) The new carbonates can be used in perfumes, whereas pineapple ketone is unstable leading to changes in the fragrance profile over time and discoloration of the formulation;
- d) The new carbonates prolong flavor in chewing-gum and bubble-gum.

Exemplary of the preferred extended flavor compounds and the invention are:

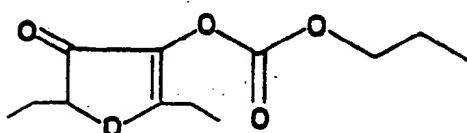
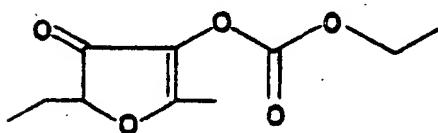


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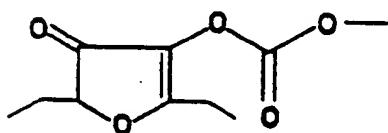
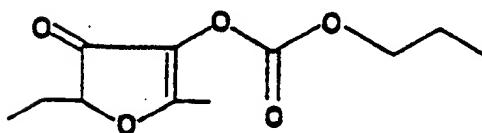
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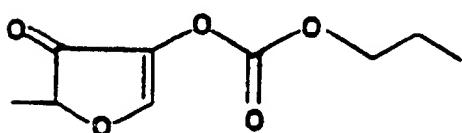
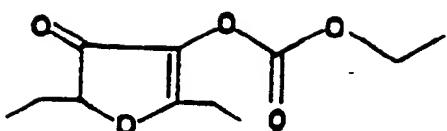


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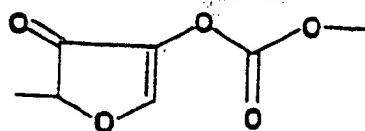
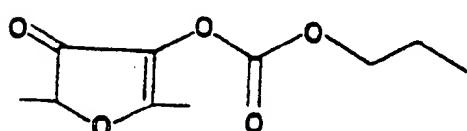


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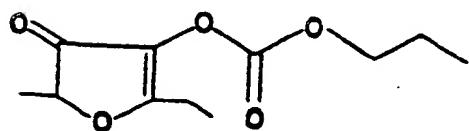
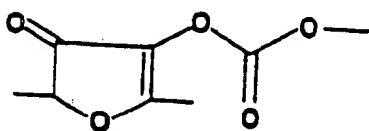


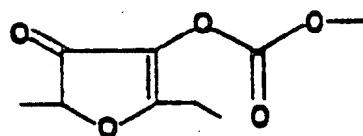
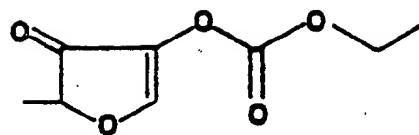


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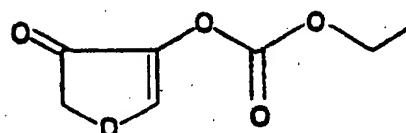
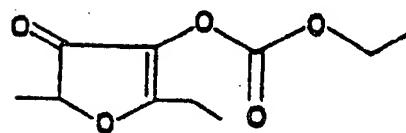


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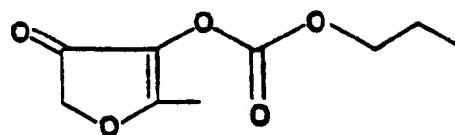
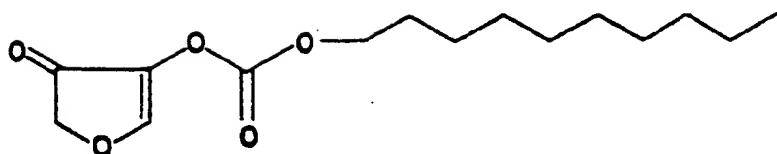




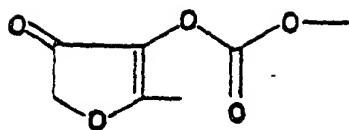
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and



EXAMPLE 1

PREPARATION OF ETHYL 2,5-DIMETHYL-3-OXO-4(2H)-FURYL CARBONATE

5 A solution of 2,5-dimethyl-4-hydroxy-3(2H)-furanone (pineapple ketone, 133.0g, 1.0 mole) and triethylamine (152.0g, 1.5 moles) in methylene chloride (665g) is cooled to 5°C under nitrogen atmosphere. To the cooled solution is added over a period of 2.5 hours, a solution of ethyl chloroformate (127.7g, 1.18 moles) in methylene chloride (600g) 10 stirred at 5-8°C for two additional hours. The reaction mixture is filtered through a Buchner funnel to remove the triethylamine hydrochloride. The salt is washed with methylene chloride (200 ml). The combined organic layers are 15 washed twice with 100ml portions of water and dried over sodium sulfate. The solvent is removed in vacuo and the crude product distilled (0.1 torr) through a Goodloe column to yield 72.5% of ethyl 2,5-dimethyl-3-oxo-4(2H)-furyl carbonate product b.p. 87°C (0.08 torr), IR (neat film) 2980(M), 1770(S), 1715(S), 1640(S), 1250(S) cm^{-1} , ^1H NMR 1.58(t,J = 8Hz,3), 1.65 (d,J = 7Hz,3), 2.32 (s,3), 4.45 (q,J = 7Hz,2), 4.75 (q,J = 7Hz,1), and 3.3% of the diadduct, diethyl 2,5-dimethyl-3,4-furyl dicarbonate, b.p. 110°C (0.08 torr), 20 IR (neat film 2980(M), 1770(S), 1250(S), ^1H NMR = 1.50 (t,J = 6Hz,6) 2.3 (s,6) 4.45 (q,J = 8Hz,4). 25

EXAMPLE 2

PREPARATION OF METHYL 2,5-DIMETHYL-3-OXO-4(2H)-FURYL CARBONATE

30 A solution of 2,5-dimethyl-4-hydroxy-3(2H)-furanone (pineapple ketone, 44.0g, 0.33 mole) and triethylamine (50.5g, 0.5 mole) in methylene chloride (220g) is cooled to 5°C under nitrogen atmosphere. To the cooled solution is

added over a period of 2.0 hours, a solution of methyl chloroformate (38.6g, 0.41 mole) in methylene chloride (200g), which is then stirred at 5-8°C for two additional hours. The reaction mixture is filtered through a Buchner funnel to remove

5 the triethylamine hydrochloride. The salt is washed with methylene chloride (200 ml). The combined organic layers are washed twice with 100 ml portions of water and dried over sodium sulfate. The solvent is removed in vacuo and the crude product distilled (0.1 torr) through a Goodloe column to

10 yield 18g of methyl 2,5-dimethyl-3-oxo-4(2H)-furyl carbonate product, b.p. 105°C; IR (neat film) 2960(M), 1770(S), 1710(S), 1640(S), 1250(S), 1200(S) cm^{-1} ; ^1H NMR 1.55(d, $J = 8\text{Hz}$, 3), 2.28 (s, 3), 3.95 (s, 3), 4.70 (q, $J = 8\text{Hz}$, 1).

EXAMPLE 3

15 OXIDATIVE STABILITY OF ETHYL 2,5-DIMETHYL-3-OXO-
4(2H)-FURYL CARBONATE

Solutions containing respectively 10 percent carbonate and ten percent pineapple ketone in toluene are stirred in loosely capped vials at ambient temperature. Samples are

20 taken periodically and the concentration of carbonate or ketone remaining determined by GLC (6' x 1/8", 15% Carbowax-20M on 80/100 Chromasorb W, Helium = 28 cc/min, 100°-210° at 8°/min). The experiment is repeated using ethanol as solvent. Results are shown below.

25 COMPARATIVE STABILITY IN AIR
(TOLUENE, AMBIENT TEMPERATURE)

	PINEAPPLE KETONE		ETHYL CARBONATE OF EXAMPLE 1	
	Time (hours)	% Remaining	Time (hours)	% Remaining
	0	100	0	100
30	15	24	17	100
	41	18	40	100
	116	6	117	100
	138	4	137	100

COMPARATIVE STABILITY IN AIR
(ETHANOL, AMBIENT TEMPERATURE)

PINEAPPLE KETONE		ETHYL CARBONATE OF EXAMPLE 1	
<u>Time (hours)</u>	<u>% Remaining</u>	<u>Time (hours)</u>	<u>% Remaining</u>
5	0	0	100
	21	21	100
	48	46	100
	72	69	100
	149	149	100
10	172	173	100

EXAMPLE 4
BUBBLE GUM

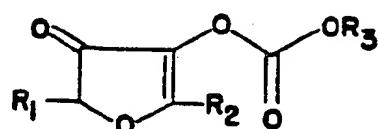
A typical bubble gum base is made with the following ingredients:

15	Bubble Base T, Acid Balanced (L. A. Dreyfus Co., South Plainfield, NJ)	135.00 parts
	Corn syrup, 43° baume	161.25 parts
	Powdered sugar, confectioners 10X	450.00 parts
	Citric acid	3.75 parts
20	Glycerine	3.75 parts
	Flavors	7.50 parts

All ingredients are mixed in a gum blender with a jacketed sidewall. To gum A is added 7.50 parts strawberry flavor 500389-U (Hercules, PFW Division, Middletown, NY). To gum B 25 is added 7.125 parts strawberry flavor 500389-U, plus 0.375 parts of ethyl carbonate pineapple ketone derivative from Example 1. The gums are cut into 5.0 grams pieces and evaluated by panelists. Both gums A and B have a long-lived strawberry flavor, with gum B having a higher overall rating 30 for flavor prolongation after 10 minutes, as well as, having a higher and more sustained flavor intensity peak during the middle of the chew. Gum B has the best retained strawberry character throughout the chew.

Other features, advantages and specific embodiments of this invention will become readily apparent to those exercising ordinary skill in the art after reading the foregoing disclosures. In this regard, while specific 5 embodiments of this invention have been described in considerable detail, variations and modifications of these embodiments can be effected without departing from the spirit and scope of the invention as disclosed and claimed.

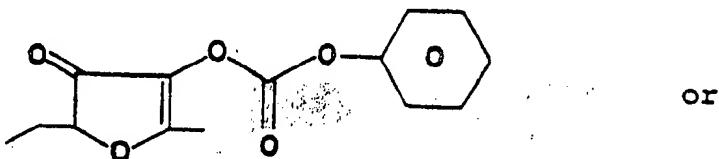
1. A compound of the general formula,



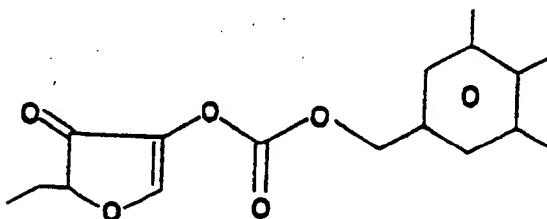
5 wherein R₁ and R₂ independently are -H, -CH₃, or -CH₂CH₃; and R₃ is alkyl of from 1 to 10 carbons or aryl of from 6 to 10 carbons.

2. The compound of claim 1 having the formulas:

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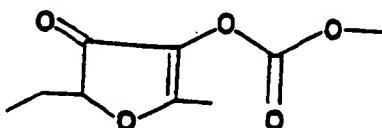


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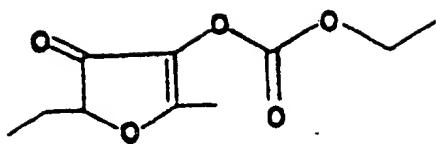


3. The compound of claim 1 having the formulas:

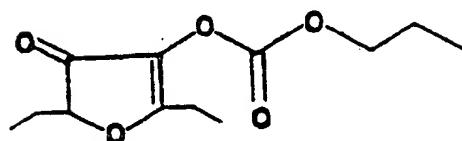
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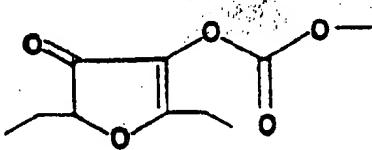
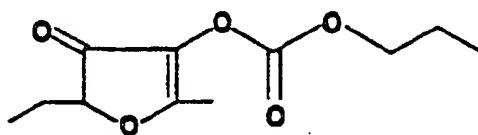
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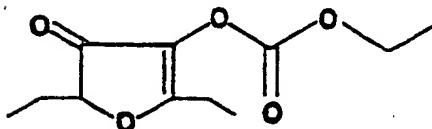
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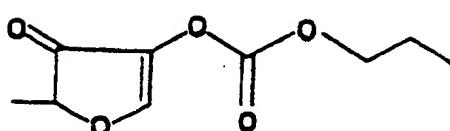
5 4. The compound of claim 1 having the formulas:



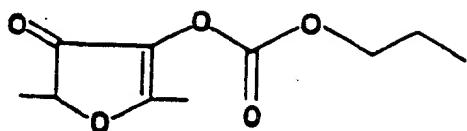
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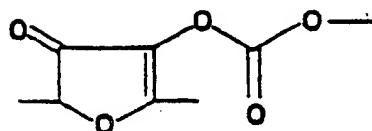
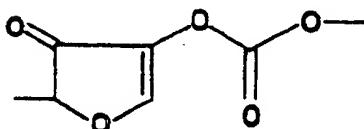
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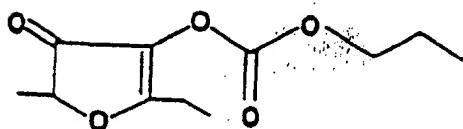
5. The compound of claim 1 having the formulas:



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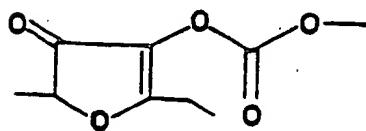
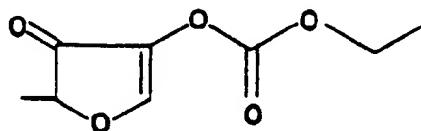


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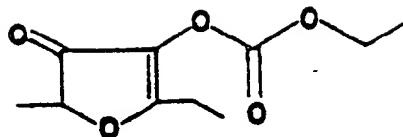


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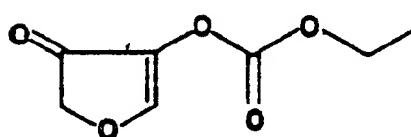
6. The compound of claim 1 having the formulas:



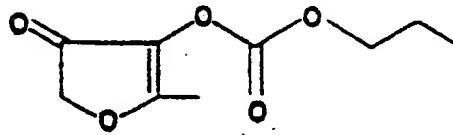
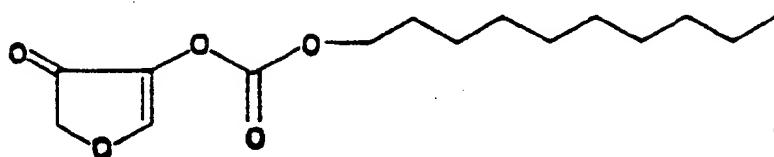
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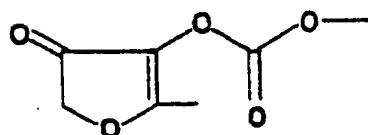
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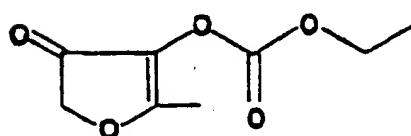
5 7. The compound of claim 1 having the formulas:



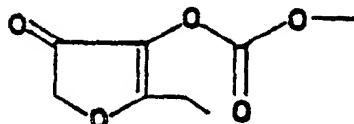
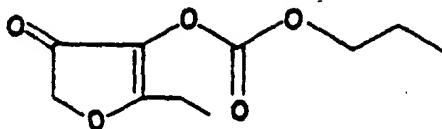
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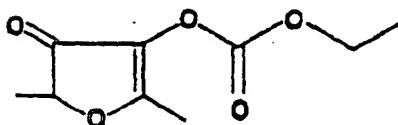
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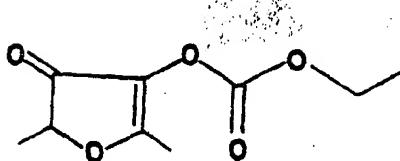
8. The compound of claim 1 having the formulas:



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or



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9. The compound of claim 1 in combination with a perfume and/or a fragranced composition.

10. The compound of claim 1 in combination with a flavor and/or foodstuff.

11. The compound of claim 1 wherein said foodstuff is 15 chewing gum or bubble gum.

12. The compound of claim 1 in combination with toothpaste or tobacco.